[Chapter 8] International recycling by South Korea in the context of green growth

AUTHOR(S):

Kim, Soyoung; Mori, Akihisa

CITATION:

Kim, Soyoung ...[et al]. [Chapter 8] International recycling by South Korea in the context of green growth. Green Growth and Low Carbon Development in East Asia 2015: 140-158

ISSUE DATE:

2015-05-08

URL:

http://hdl.handle.net/2433/254133

8. International Recycling by South Korea in the Context of Green Growth

Soyoung Kim and Akihisa Mori

Abstract

This chapter evaluates South Korea's international recycling under the Extended Producer Responsibility (EPR) program, examining it in a framework of green growth. Through detailed field research and a cost–benefit incidence analysis, it is found that the program brings economic benefits to South Korean EPR producers and exporters, and ecological benefit to the South Korean government, but at the cost of increased occupational health risk in Vietnam. This risk accrues from insufficient countermeasures against illegal export disguised as reuse and from substandard recycling.

Introduction

The Seoul Initiative was adopted at the 5th Ministerial Conference on Environment and Development in Asia and the Pacific (MCED-5) in 2005 with the aim of addressing major policy issues pertaining to green growth and encouraged an international discussion on green growth. Maximizing social benefit while minimizing ecological impact is regarded as a basic principle of green growth (UNESCAP, 2008).

Faced with the global economic recession that was at its worst in late 2008, President Myung Bak Lee of South Korea laid out a "Low Carbon, Green Growth" strategy as a new means of domestic economic development and set the ambitious goal of 7% growth per annum (Cho, 2010). The Low Carbon, Green Growth strategy defines its goals as "growth achieved by saving and using energy and resources efficiently to reduce climate change and damage to the environment, securing new growth engines through research and development of green technology, creating new job opportunities, and achieving harmony between the economy and environment" (KPMO, 2010, art. 2).

One of the important characteristics of South Korean green growth is that the aim is to ensure that resources are more used efficiently across the whole economy. Toward this end, resource productivity has been adopted as a key policy indicator for green growth (GGK, 2009). Resource productivity refers to the monetary yield per unit resource of domestic material consumption.

South Korea implemented the Extended Producer Responsibility (EPR) program as one of the main policy tools for green growth. This program is expected to increase the efficiency of resource use and eco-production. The EPR program focuses on two aspects: implementing a mandatory domestic recycling system, and reducing the amount of toxic material used in production (KMOE, 2010). EPR is a policy concept recommended by OECD in 2001 (OECD, 2001) and advocated as a tool for environmentally

sound management of waste (OECD, 2007). OECD defines EPR as “an environmental policy approach in which a producer’s responsibility for a product is extended to the post-consumer stage of a product`s life cycle” (OECD, 2001: 9). EPR aims at internalizing the negative externalities accrued from the whole life cycle of a product as a means of improving overall social welfare (Walls, 2004). Most OECD countries are implementing EPR programs in key sectors (OECD and JMOE, 2014).

The resource productivity of developed countries tends to increase with economic globalization. This is attributed to a gradual change in the structure of economic activity from resource-based and labor-intensive production to skill- and capital-intensive production (Alcorta, 2012). This structural change additionally increases the export of recyclable and hazardous waste from developed countries to developing countries (Taketoshi, 2009), which can result in increasing the resource productivity of developed countries simultaneously with increasing the negative externalities in developing countries. Rauscher (2001) asserted that, theoretically, international trade of hazardous waste is beneficial to the exporting countries, with the benefits increased by environmental laxity in the importing countries. When there is insufficient regulatory oversight in the waste disposal and processing industries, negative gains may be accrued to the importing countries, and this may cause welfare losses for the world as a whole. Therefore, to achieve global green growth, policies need to be implemented that will avoid the transfer of negative externalities from developed countries to developing countries.

In recent years, large amounts of waste of electrical and electronic equipment (WEEE) have been exported to developing countries. WEEE includes hazardous substances that can damage the environment and human health if not properly handled. International trade of WEEE can lead to welfare losses in developing countries where environmental governance is not sufficient to internalize the negative externalities. International trade of hazardous waste is regulated by the Basel Convention. However, there is no internationally unified regulatory framework for the international trade of used products. As a consequence, a great amount of WEEE was brought into non-OECD countries in the guise of used products intended for reuse (Nnorom et al., 2011).

As of 2009, in South Korea, WEEE regulated by the EPR program is collected at a rate of only 23–28% for televisions, washing machines, and refrigerators, and 7% for air conditioners (Kim et al., 2013). The flow of WEEE that is not collected under the EPR program has not been published. Accurate data on illegal exports of used electronics is not publicly available. However, according to the Japan China Commodities Inspection Company, only 28 cases of exports of used electronics from South Korea to China were found to be illegal in 2005 (Ahn, 2006). The reasons for those rejections were mixing of unsanitary or forbidden waste, falsification of export permits, and failing to undergo a preliminary inspection before shipment (Ahn, 2006). It is known that there were ship-backs of illegally exported used

electronics disguised as products intended for reuse (KMOE, 2012a).

Against this background, this chapter first explores features of WEEE management in South Korea to focus on the institutions involved in the export of used electronics. The export rates of five types of goods are estimated and the export destinations of used cathode ray tube (CRT) computer monitors are identified. CRT monitors are chosen because they contain a very high concentration of toxic metals because of the lead included in the CRT glass (Oguchi et al., 2013). Field research in Nhat Tao market in Ho Chi Minh City, Vietnam, was used to create a cost–benefit incidence analysis in order to show how the benefits and costs of the export of CRT computer monitors are allocated under South Korea's international recycling program.

Features of EPR programs for WEEE management

WEEE management in South Korea is the same as that in the European Union (EU) and Japan in that it focuses on mandatory recycling systems and the restriction of the use of certain hazardous substances (RoHS) in manufacturing covered by the EPR program. In South Korea, a mandatory recycling system for producers was implemented in January 2003 under the Act on the Promotion of Saving and Recycling of Resources. This law was superseded by the Act for Resource Circulation of Electrical and Electronic Equipment and Vehicles (ARCEEEV) in February 2008; ARCEEEV encompasses both recycling and RoHS. As of 2014, 26 types of electronics are regulated by the law.

[Table 8.1]

South Korea has three unique features in comparison with the EU and Japan. First, South Korea exempts certain manufacturers and importers (producers) of regulated electronics from recycling duty on the basis of their production size (KMOE, 2014b, art. 14–15).

Second, a producer's duty in the EPR program is different from that of a producer in the EU or Japan. The South Korean recycling program assigns EPR producers both a minimum recovery target per unit and a quota for the recycling of targeted electronics. Recycling refers to the whole process of changing WEEE into recovered materials in facilities approved for that purpose (KMOE, 2012b). If the quota is not met, a fine that is set to greater than the cost of implementing proper recycling for the missing volume is imposed upon the EPR producers (KMOE, 2014a, art. 18). The recycling target of EPR producers is 6 kg per inhabitant per year, adjusted to reflect their share of total domestic shipment, by 2016 (KMOE, 2014c). In the EU, collection targets refer to the separately collected volume by producers, distributors, and collection facilities (including municipal facilities), but there is no penalty to producers for not achieving this failure. Japan does not impose a collection or recycling target on producers, but it requires

producers of regulated electronics to achieve a minimum recovery target per unit.

Third, by determining the volume of recycling conducted by EPR producers, the South Korean government has qualified the export of used computer monitors for the purpose of reuse as legitimate recycling since 2004 (KMOE, 2003, 2012b). In fact, EPR producers requested this international recycling program for used computer monitors (Chung and Yoshida, 2008). EPR producers achieve the recycling target of computer monitors by paying exporters for documentary evidence of an export declaration issued by customs[1]. South Korea does not delineate a particular strategy to combat the illegal export of used electronics. The export of used electronics for direct reuse is exempted from related duty imposed on waste trade (KMOE, 2012a). The criteria for exemption from duty refer to "used electronics which function fully, have a contract ensuring the export for the purpose of direct reuse and have a document of evaluation on products' functionality from the destination country" (KMOE, 2012a:308). However, exporters of used electronics are not required to prove that the exporting products are actually eligible for exemption[2].

In the EU a large proportion of WEEE is sent from retailers and municipalities to exporters after it is separately collected from consumers (EERA, 2007), and this amount is still counted in the collection rate target. It is unclear how many of these exporters engage in illegal practices. The EU set forth two main measures to deter illegal export of used electronics. One measure is to strengthen export inspections by requiring exporters to prove that the shipped items are reusable electronics intended for direct reuse, not WEEE, when requested by an inspection authority (WEEE Recast, 2012, art. 23, cl. 2). The cost of inspections and analyses for monitoring used EEE suspected to be WEEE can be charged to the producers or exporters (WEEE Recast, 2012, art. 23, cl. 3). The other measure is to set a high collection target to prevent the illegal export of used electronics by informal exporters (WEEE Recast, 2012, (15)).

In Japan, as a measure to curb illegal export of used electronics, Japan has regulated used home appliances and computer monitors since 2008 by using the Harmonized Commodity Description and Coding System (HS code) to categorize exports. Japan provides exporters with a prior consultation and presents a more detailed standard for the self-evaluation of legal exports of used electronics than is provided in South Korea and the EU. This standard is composed of five components: life span (below 15 years for air conditioners and televisions; below 10 years for freezers, refrigerators, washing machines, and clothes dryers) and appearance, function, packaging and loading, a contract proving sales for direct reuse, and empirical evidence of sales of direct reuse (JMOE, 2013).

[1] Interview with the head of the International Cooperation Department of the Association of Electronics Environment (AEE), 7 February 2014.
[2] Interview with the Export Control Officer of Incheon Customs, 23 September 2014.

Theoretical explanation of international recycling in South Korea

Fig. 8.1 presents a simplified economic model of an EPR domestic recycling management scenario. In the diagram, P_R is the marginal revenue for recyclers and MC_R is the marginal cost of recycling. Thus, $P_R - MC_R$ is the marginal profit from recycling. MC_L is the marginal cost of landfill disposal. The value of $P_R - MC_R$ is read from left to right and the value of MC_L is read from right to left; hence, the value of $P_R - MC_R$ decreases with volume and MC_L increases with volume.

[Fig. 8.1]

In this instance the recycling level in the market will normally be W_p, which is where recyclers' profits are maximized. We assume that the government imposes duties on producers to achieve the recycling level W^* that represents the optimal levels of recycling and landfill use. In this case, producers have to bear costs corresponding to b + c + d. In contrast, recyclers have gains of the area a + b + c, and society's cost of landfill is e.

[Fig. 8.2]

Fig. 8.2 shows the domestic market for used computer monitors in South Korea. The domestic equilibrium price before trade (A) is below the world price (WP), which means that South Korea will be a net exporter. We assume that the line segment W_pW^* of Fig. 8.1 and BC of Fig. 8.2 are the same. Owing to the international recycling program, EPR Producers can fulfill the volume of recycling duty corresponding to the line segment BC by providing exporters with a payment in exchange for export declarations for used computer monitors. In this case, the cost to the producers corresponds to the shaded area f. Theoretically, this can result in the increase of the supply to the length of the line segment DE because it has the same effect as increasing the product price by the amount of payment from producers to exporters (Chung and Yoshida, 2008).

[Table 8.2]

Through international recycling, the producer's additional savings is the area –f + b + c + d. Recyclers suffer a loss of –b – c. For society, there is no change so long as the same residue for landfill disposal remains after recycling, and exporters can make additional profits corresponding to f. The additional net benefit of the international recycling is d as a whole. Our theoretical analysis implies that the South Korean government adopted the international recycling program for used computer monitors to increase recycling and accrued gains at the same time.

Exports of used computer monitors in action

Data

International trade of used electronics and new electronics are not differentiated by HS codes, which are used globally for the classification of trade commodities, up to the level of 6 digits. Some countries, such as Japan, specify additional digits for the HS codes to classify used electronics. However, it is difficult for most countries to quantify the trade of used electronics from only trade statistics.

Because South Korea does not specify extended HS codes for used electronics, we examine the details of export declarations to estimate the total export volume of used electronics. In this paper, we examine five types of electronic appliances: air conditioners, computer monitors, refrigerators, televisions, and washing machines. The HS codes for the selected electronics and details of the method for selecting data are provided in the Appendix.

Because the export volume of used electronics in this paper is based on self-declarations by exporters, undeclared export shipments are not included in the export volume. In particular, comprehensive data on export freight of monetary value less than two million KRW are not available. The reason for this is that it is not necessary to declare such exports in South Korea; this exemption is based on South Korea Customs Service Notification (2014).

In order to observe the time-series data of exported used electronics not including fluctuations in the amount of discarded electronics generated in South Korea, we quantified the export rate on the basis of the volume of discarded electronics. The export rate is calculated by dividing the exported volume of the used electronics by the volume of discarded electronics generated in South Korea. For annual volumes of discarded electronics, we referred to Kim et al. (2013). Those data were estimated from sales data by using a delay model that considers the product lifespan distribution. The volume of computer monitors was updated to agree with the data according to the same method[3].

The volume of discarded computer monitors is estimated from sales data (IDC Korea, 2010; KOSIS) and a product lifespan distribution. The shape parameter of the lifespan distribution of computer monitors is fixed at 2.4 in this paper. This value is chosen because it represents the average shape of the 22 types of electronics (Oguchi et al., 2006). The average lifespan of computer monitors was assumed to be 5–6 years according to the Public Procurement Service (2011) and Baek (2006).

Export rate

The export rates of used electronics are shown in Fig. 8.3. The export rates of used air conditioners and

[3] See Kim et al. (2013) for a complete description of the estimation procedure.

washing machines were estimated at below 1%, and refrigerators were below 3% during 2002–2009.

[Fig. 8.3]

Since 2002, the export rates of used computer monitors have increased, reaching 59% in 2009. During the entire period, most exported used monitors were CRT monitors. The export rates of used televisions were relatively low in comparison with the rates for used computer monitors, ranging between 11% and 24%. Since 2007, used flat screen televisions have accounted for around 40% of total exports of used televisions. It is noteworthy that the export rate of computer monitors declined in the years 2004 and 2007 despite EPR producers' payments to exporters of used computer monitors.

Export destination

[Fig. 8.4]

CRT computer monitors were directed mostly to Asian countries during the entire period. The main destinations for used CRT monitors were Hong Kong (2003–2006) and Vietnam (2007–2009). Drastic decreases of export volume to Hong Kong can be observed in 2004 and 2007. The export rates of used computer monitors mirror those changes for those years (see Fig. 8.3).

Hong Kong is famous as an entrepôt of China for recyclable resources and secondhand products (Kojima and Yoshida, 2007). As contamination by electronic waste in China intensified, the Environmental Protection Department (EPD) of Hong Kong conducted investigations and uncovered illegal electronic waste disguised as reusable electronics in 2003 (Kojima and Yoshida, 2007). In July of 2004, the EPD required the South Korean government to enact countermeasures against illegal export of used electronics (Byun, 2004). In April 2006, Hong Kong adopted a stringent policy, issuing the Advice on Import and Export of Used Electrical and Electronic Appliances having Hazardous Components or Constituents (EPD, 2006). Although exports to Hong Kong were decreased in response to these stringent regulations in 2004 and 2007, South Korea's total export volume of used CRT monitors has not declined since then. Instead, the main destination changed from Hong Kong to Vietnam. In 2009, 74% of export volume of used CRT monitors was headed for Vietnam.

Market conditions of Vietnam

Entrepôt for used electronics

Vietnam has economic and geographical conditions that make it likely to replace Hong Kong as an entrepôt for the trade of used electronics. It shares borders with China and some ASEAN countries.

Vietnam has belonged to the ASEAN Free Trade Area (AFTA) since July 1995, and, as of 2008, Vietnam's import tariff is below 5% for 98% of the products in the Inclusion List when imported from an AFTA country (ASEAN, 2008). It has been below 5% for 45% of the products when imported from South Korea since the South Korea-ASEAN FTA took effect in 2007 (KMOFAT, 2011). In July 2005, Vietnam started abolishing tariffs with China (KMOFAT, 2011). Vietnam further exempts goods imported temporarily for re-export from tariffs and value-added taxes (JETRO, 2014; HSK Vietnam Audit company).

To protect the domestic market and the environment, Vietnam takes measures to avoid the illegal inflow of used electronics. In principle, Vietnam bans the import of used electronics (GOV, 2006), especially used information technology appliances such as CRT computer monitors, desktop computers, mobile phones, and televisions (MOPTV, 2006). However, Vietnam allows the temporary import of used electronics intended for re-export (GOV, 2006). In 2012, Vietnam prohibited the import of refrigerators containing chlorofluorocarbon refrigerants, desktop computers, and televisions, even for the purpose of re-export (MOITV, 2012). Items not specified in MOITV (2012) can be legally imported for the purpose of re-export; hence, used computer monitors are still allowed to be imported into Vietnam so long as they are intended for re-export.

Hai Phong Harbor and Mong Cai City in northern Vietnam share a border with the city of Dongxing in China and act as hubs for the trade in used electronics (Shinkuma and Huong, 2009). Hai Phong harbor works as an export route to China, and is a known port for smuggling (Terazono and Yoshida, 2012). From Mong Cai city, a large amount of imported used electronics goes into Dongxing before being transported to Guangzhou (Shinkuma and Huong, 2009). Electronic waste from Guangzhou is supplied to Guiyu, which is in the same province (Lee, 2002). Plastic recovered in Guiyu is supplied to many global electronics companies (Watson, 2013).

Guiyu is widely known to experience severe environmental pollution as a consequence of substandard recycling of electronic waste (Leung et al., 2006). High levels of lead are present in the blood of children; high concentrations of persistent organic pollutants (POPs), such as flame-retardants, are present in various environmental media; and dioxin pollution is known to be severe (Huo et al., 2007; Wong et al., 2007; Li et al., 2007). These problems accrue from the hazardous constituent materials in the electronics in combination with improper recycling processes.

Another hub of trade in used electronics in the south central part of Vietnam is the Nhat Tao Market in Ho Chi Minh City. Used electronics are typically brought to Nhat Tao Market through Da Nang Port, Saigon Port, and the Sihanoukville Port in Cambodia (Hai et al., 2005; Shinkuma and Huong, 2009; Kojima,

2005).

Case study of Ho Chi Minh City

In Vietnam 17.3% of households have a computer and 90.3% have a television (General Statistics Office of Vietnam, 2012). This implies that demand for computer monitors is low, while that for new and replacement television purchases is high and stable.

New CRT televisions have not been sold in the market since 2014 because the Vietnamese government is pushing the transition from analog to digital broadcasting, with completion slated for 2020, and has banned production and import of televisions that cannot receive digital television signals (MOICV, 2013). However, CRT televisions are sold in the Nhat Tao market. CRTs removed from computer monitors are mostly used for rebuilding CRT televisions[4]. This is due in part to low demand for used CRT computer monitors and in part to high demand for CRT televisions. Rebuilding refers to not only refurbishment (which usually includes tests for functionality and defects before selling) but also changes and capability upgrades[5]. The price of a rebuilt 17-inch CRT television is around 35 USD, compared with around 300 USD for a brand new 32-inch flat screen television[6].

Occupational health risks for recyclers and exposure of their children to high levels of toxins via breast milk are reported at Vietnamese electronic waste recycling sites (Tue et al., 2010). Occupational health risks are also high at the plastic recycling factories in the outskirts of Ho Chi Minh City. Such factories operate in a closed environment to conceal the smell of combustion of plastics and to avoid public attention[7]. A huge volume of plastic waste is gathered in Ho Chi Minh city in response to active Chinese brokers who export many types of recovered materials from Cambodia and south central Vietnam to China (Yoshida, 2013).

According to retailers at the two markets, the CRT computer monitors exported from South Korea to Vietnam are mainly re-exported to Guangzhou, China or circulated domestically. In Guangzhou and Ho Chi Minh City, the rebuilding of used electronics is a thriving industry. Although the rebuilding process itself does not seem to cause severe environmental problems, parts that remain after rebuilding and used electronics unsuitable for rebuilding are supplied to substandard recyclers, who cause environmental pollution. Coupled with the above occupational health risks, it is highly likely that the negative externalities of CRT computer monitors are being transferred to Vietnam.

---

4 Interview at Nhat Tao Market, 28 March 2014.
5 Interview at Nhat Tao Market, 28 March 2014.
6 Interview at Nguyen Thi Minh Khai, 27 March 2014.
7 Interview at plastic recycling factory on Ao Doi street, 28 March 2014

[Fig. 8.5]

Cost–benefit analysis for used CRT computer monitor exports

South Korea admits the export of used computer monitors for the purpose of reuse as legitimate recycling. Additional benefits of export of used CRT computer monitors are estimated against domestic recycling in South Korea (Table 8.3). Our estimate shows that international recycling programs accrue a net benefit to South Korea.

[Table 8.3]

In domestic recycling carried out under the EPR recycling program, producers provide reprocessing companies with a payment of 3,102 KRW per unit to cover collection and recycling costs (AEE, 2012). International recycling enables producers to save 2,506 KRW per unit because the producers pay only 596 KRW per unit to the exporters (AEE, 2012). Exporters obtain an additional profit of 596 KRW per unit from EPR producers in return for reporting the export (AEE, 2012). On the other hand, international recycling deprives reprocessing companies of sales revenue of 3,426 KRW per unit and producers' payments of 3,102 KRW per unit, while saving 3,907 KRW per unit that is supposed to spend for recycling costs (AEE, 2012, 2013). The government additionally saves landfill disposal costs of 304 KRW per unit, where a unit corresponds to 9.5 kg of incombustible waste because the recycling rate of a CRT monitor is 38% (5.8 kg of 15.3 kg is recycled) (AEE, 2013). From interviews and observation at Nhat Tao market, we can guess that Vietnamese recyclers and consumers gain a bit at the cost of health and environmental risks.

In total, the net benefits from international recycling are estimated as at most 785 KRW per unit. In 2009, EPR producers exported 406,886 units of used CRT computer monitors as international recycling (KECO, 2013). In total, 320 million KRW can be estimated as net additional benefits to South Korea from international recycling in 2009. The larger concern is the health and environmental cost in Vietnam, which overshadows the smaller net benefit generated from the international recycling program.

Discussion

In South Korea, used electronics that satisfy certain criteria are exempted from related duties imposed on waste export at the time of export. In addition, exporters of used electronics are not required to prove that the exporting products are eligible for exemption. Our estimate shows that 74% of the export volume of used CRT computer monitors headed for Vietnam were marked as being for reuse in 2009. This implies that South Korea does not strictly implement a monitoring system for export of used electronics because Vietnam permits only temporary import for re-export, not for reuse. EPR producers must ensure that

exporters submit an export declaration, issued by customs, for the used computer monitors. However, they do not have to ensure proper reuse and/or re-export at the export destination[8]. Exporters of used electronics do not face any sanctions for noncompliance unless they are uncovered at the time of export inspection.

The EU and Japan require exporters of used electronics to act more responsibly than is required in South Korea. The EU requires member states to strictly monitor for illegal exports of used electronics and clarifies that the relevant costs for inspection of used electronics suspected to be WEEE will be imposed on producers. The Japanese government presents a detailed standard for the used electronics and specifies the HS code for selected used electronics as a way of making the flow transparent. Compliance of exporters still depends on the strictness of government inspections.

This implies that comparably less stringent countermeasures against illegal and fraudulent export of used electronics have been established in South Korea than in the EU and Japan. These less stringent measures incentivize exporters of South Korea to export WEEE under the guise of reuse and encourages importers having a contract with exporters of South Korea to shirk their responsibility to prove a sale for direct reuse.

In the future, RoHS-type legislation in South Korea, the EU, and Japan may reduce the transfer of negative externalities via international trade of used electronics. However, the impact of such legislation can be quite limited because South Korea sets a target of only 26 types of electronics for an RoHS framework.

Conclusion

One purpose of green growth is to achieve economic growth that maximizes social welfare while minimizing ecological impact (UNESCAP, 2008). South Korea aims to achieve this purpose through international recycling. This chapter demonstrates theoretically and empirically that EPR producers, exporters, and the government of South Korea obtain economic gains from international recycling and that this will increase South Korea's resource productivity. However, these gains come at the expense of health and environmental risks to importing countries, such as Vietnam.

The identified gains, however, accrue in part from South Korea's insufficient system for monitoring against illegal or fraudulent export of used electronics. Materials to prove that the exporting object is functionally reusable and directly reused in destinations are not monitored, and this causes severe asymmetry of information regarding the condition of exported objects. To maximize the economic and

[8] Interview with the head of the International Cooperation Department of AEE, 7 February 2014.

environmental benefits both domestically and globally, and to minimize negative externalities in the importing countries, South Korea should establish a more stringent monitoring system and enforce it more strictly.

References

AEE (Association of Electronics Environment of South Korea) (2012). Price of recycling credits for 2011 and 2012. Seoul, print (in Korean).

AEE (2013). Recycling cost analysis of waste of electrical and electronic equipment. Seoul, print (in Korean).

Ahn, H. J. (2006). *Proceeding for Parliamentary Inspection of the Government Offices* (during 13-27 October). Seoul, The South Korean National Assembly (in Korean).

Alcorta, A. L. (2012). Climbing the stairway of development, *UNIDO Policy Brief*, issue 2(May), 1-4.

ASEAN (Association of Southeast Asian Nations) (2008). Consolidated CEPT Package, 2008-Viet nam. Retrieved from http://www.asean.org/communities/asean-economic-community/category/other-documents-24

Baek, B. S. (2006). *Lifespan by Item for Compensation of Consumers` Damage*. Seoul, Korea Consumer Agency (in Korean).

Byun, H.S. (2004, July 4). China demands for “preventing illegal export of e-wasste” to the Korean government, *Hankook Ilbo Newspaper* (in Korean).

Cho, M. R. (2010). International conference of interconnections of global problems in East Asia- Is the green economy secure in South Korea?: Dissecting Korea`s green growth strategy, held in Namdaemunro by Seoul by Hanshin Univ. and Nautilus institute on October 18-21, 2010.

Chung, S. W., and Yoshida, F. (2008). A study of the WEEE (waste of electrical and electronic equipment) recycling and export in South Korea. *Journal of the Japan Society of Waste Management Experts* 19 (4), 235-243 (in Japanese).

EERA (European Electronics Recyclers Association) (2007). *Towards Sustainable WEEE Recycling - Proposals for the Revision of the Relevant Provision of the WEEE Directive*. Arnhem, EERA.

EPD (Environmental Protection Department of Hong Kong) (2006). Advice on import and export of used electrical and electronic appliances having hazardous components and constituents. Retrieved from http://www.epd.gov.hk/epd/english/environmentinhk/waste/guide_ref/files/advice_on_e-waste.pdf

General Statistics Office of Vietnam (2012). Percentage of households having main durable goods by urban, rural region and sex of household head. Retrieved from http://www.gso.gov.vn/default_en.aspx?tabid=491

GGK (Green Growth South Korea) (2009). *National Strategy for Green Growth*. Seoul, GGK (in Korean).

GOV (Government of Vietnam) (2006), Decree 12/2006/ND-CP. Making detailed provisions for implementation of the commercial law with respect to international purchases and sales of goods; and agency for sale and purchase, processing and transit of goods involving foreign parties.

Hai, H. T., Mai, C.X., and Huong, H.T. (2005). Current status of electronic waste and its treatment technology in Hanoi, in *Proceeding of the Second NIES Workshop on E-waste* held on November 23, 2005, 105-111.

HSK Vietnam Audit Company. Outline of value added tax in Vietnam (in Japanese). Retrieved fr om http://www.hskv.com.vn/ja/information/summary-of-regulation/32-value-added-tax

Huo, X., Xu, X., Zheng, L., Qiu, B., Qi, Z., Zhang, B., Han, D., and Piao, Z. (2007). Elevated blood lead levels of children in Guiyu, an electronic waste recycling town in China. *Environmental Health Perspective*s 115 (7), 1113-1117.

IDC Korea (2010). *Analysis of PC monitor market and prospect*. Seoul, IDC Korea (in Korean).

JETRO (Japan External Trade Organization) (2014). Basic information on export and import polic ies of Vietnam (in Japanese). Retrieved from http://www.jetro.go.jp/world/asia/vn/trade_03/#blo ck3

JISC0950 (2008). The marking for presence of the specific chemical substances for electrical and electronic equipment (in Japanese). Retrieved from http://home.jeita.or.jp/eps/jmoss_en.htm

JMOE (The Japanese Ministry of Environment) (2013). Criteria for exporting secondhand electron ics (in Japanese). Retrieved from http://www.env.go.jp/press/press.php?serial=17151&mode=prin t

JOP (The Japanese Government) (2008). Law for promotion of effective utilization of resources, enforcement ordinance (in Japanese).

JOP (The Japanese Government) (2014). Home appliance recycling law, enforcement ordinance (in Japanese).

KCTDI (Korea Customs and Trade Development Institute). Export database. Web. March 2013.

KECO (Korea Environment Corporation) (2013). Recycling achievement by export under the EPR program. Incheon, Print.

Kim, S.Y., Oguchi, M., Yoshida, A., and Terazono, A. (2013). Estimating the amount of WEEE generated in South Korea by using the population balance model. *Waste Management*, 33 (2), 474-483.

KMOE (The Korean Ministry of Environment) (2003). Notification on a contractor of recycling (No.2003-212) (in Korean).

KMOE (2010). *Eco-Assurance System Guidance*. Gwacheon, KMOE (in Korean). Retrieved from http://www.keco.or.kr/kr/business/resource/communityid/115/view.do?idx=185

KMOE (2012a). *Handbook on the Export and Import of Waste*. Gwancheon, KMOE (in Korean).

KMOE (2012b). Regulation on guidelines of recycling and collection duty of WEEE (No. 450) (i n Korean).

KMOE (2014a). Act for resource circulation of electrical and electronic equipment and vehicles (ARCEEEV) (in Korean).

KMOE (2014b). Enforcement ordinance of ARCEEEV (in Korean).

KMOE (2014c, January 29). Collection target 6kg of WEEE per capita [Press release] (in Korea n). Retrieved from http://www.kdi.re.kr/infor/ep_view.jsp?num=131084

KMOFAT (The Korean Ministry of Foreign Affairs and Trade) (2011). *Commercial Environment Asia/Oceania* Vol. 2. Seoul, MOFAT (in Korean).

Kojima, M. (2005). Chapter 6 Transboundary movements of recyclable resources in South East A sia, in; Kojima, M. (Ed.), *International Trade of Recyclable Resources* (Spot survey Nr. 9). Tokyo, IDE-JETRO, 85-94.

Kojima M. and Yoshida, A. (2007). Hong Kong as an intermediary provider of recovered sources and used products, in: Kojima, M. (ed.), *Trade of Secondhand Resources in Asia.* IDE-JETRO, 70-83 (in Japanese).

KOSIS (Korean Statistical Information Service). Production data on mining and manufacturing ind ustries (Data ID: DT_1F01012). Retrieved from http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1F01012&conn_path=I3

KPMO (The Korean Prime Minister's Office) (2010). Framework act on low carbon, green growt h.

Lee, S. (2002, May 12). Ghosts in the MACHINES. *South China Morning Post Magazine*. Retrie ved from http://ban.org/library/ghosts_in.html

Leung, A., Cai, Z.W., Wong, M.H. (2006). Environmental contamination from electronic waste re cycling at Guiyu, Southeast China. *Japan Society of Material Cycles and Waste Management* 8, 21-33.

Li, H., Yu, L., Sheng, G., Fu, J., and Peng, P.A. (2007). Severe PCDD/F and PBDD/F pollution in air around an electronic waste dismantling area in China. *Environmental Science and Technology* 41, 5641-5646.

MOICV (Ministry of Information and Communication of Vietnam) (2013). Circular 07/2013/TT-BTTT, Regulating the points of time to integrate the ground digital televisions produced and imported for use in Vietnam.

MOITV (Ministry of Industry and Trade of Vietnam) (2012). Decision 5737/QD-BCT, 2012. On the temporary list of goods temporarily imported for re-export, transmitted, and in bonded warehouses.

Mok, J.H. (2005). *Improvement Plan of Waste Charge Program*. Incheon, KECO (in Korean).

MOPTV (Ministry of Post and Telecommunication of Vietnam) (2006). Decision 20/2006/QD-BBBCVT. Promulgating the list of used information technology appliances banned from import.

Nnorom, I., Osibanjo, O., and Ogwuegbu, M. (2011). Global disposal strategies for waste cathode ray tubes. *Resource, Conservation and Recycling* 55, 275-290.

OECD (Organisation for Economic Co-operation and Development) (2001). *Extended Producer Responsibility-A Guidance Manual for Government*. Paris, OECD.

OECD (2007). *Guidance Manual for the Implementation of OECD Recommendation C(2004)100 on Environmentally Sound Management of waste*. Paris, OECD.

OECD and JMOE (2014). Issues Paper. Global Forum on Environment: Promoting sustainable materials management through extended producer responsibility (EPR), held in Tokyo Prince hotel by OECD and JMOE, June 17-19, 2014.

Oguchi, M., Kameya, T., Tasaki, T., Tamai, N., Tanigawa, N. (2006). Estimation of lifetime distribution and waste numbers of 23 types of electrical and electronic equipment. *Journal of Japan Society of Waste Management Experts* 17, 50-60 (in Japanese).

Oguchi, M., Sakanakura, H., and Terazono, A. (2013). Toxic metals in WEEE: Characterization and substance flow analysis in waste treatment processes. *Science of Total Environment* 463-464, 1124-1132.

Pearce, D. (2001, August). What is a rational waste management policy, from section 1 of `Deve lopment and application of policies for promoting sustainable waste management` draft report, International Forum of the Collaboration Projects, Economic and Social Research Institute, Cabinet Office, Government of Japan.

Public Procurement Service (2011). Durable years of equipment (No. 2011-18) (in Korean).

Rauscher, M. (2001). Chapter 7 International trade in hazardous waste, in; Schulze, G.G., and Ursprung, H.W. (Eds.), *International Environmental Economics: A Survey of the Issues*. Oxford, Oxford University Press, 148-165.

RoHS Recast (2011). Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

South Korea Customs Service Notification (2014). Notification about the paperwork of the export entry (No. 2014-65) (in Korean).

Shinkuma, T., and Huong, N. (2009). The flow of E-waste material in the Asian region and a reconsideration of international trade policies on E-waste. *Environmental Impact Assessment*, 29, 25-31.

Taketoshi, K. (2009). Environmental interdependence in East Asia, in; Mori, A. (Eds.), *Economic Development and Environmental Policy of East Asia.* Tokyo, Minerva shobo, 58-79 (in Japanese).

Terazono, A., and Yoshida. A. (2012). Current international flows of electronic waste, future tasks, and possible solutions, in: Hieronymi, K. Kahhat, R., and Williams, E. (ed.), *E-waste Management.* Oxfordshire, Routledge, 137-163.

Tue, N. M., Sudaryanto, A., Minh, T. B., Isobe, T., Takahashi, S., Viet, P. H., and Tanabe, S. (2010). Accumulation of polychlorinated biphenyls and brominated flame retardants in breast milk from

women living in Vietnamese e-waste recycling sites. *Science of the Total Environment* 408, 2155-2162.

UNESCAP (2008). *Greening Growth in Asia and the Pacific*. Bangkok, UNESCAP.

Walls, M. (2004). EPR policy goals and policy choices: What does economics tell us, in OECD (ed.), *Economic Aspects of Extended Producer Responsibility.* Paris, OECD, 21-49.

Watson, I. (2013, March 31). China: The electronic wastebasket of the world. CNN Asia. Retrieved from http://edition.cnn.com/2013/05/30/world/asia/china-electronic-waste-e-waste/

WEEE Recast (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (recast).

Wong, M.H., Wu S.C., Deng, W.J., Yu, X.Z., Luo, Q., Leung, A.O., Wong, C.S. and Wong, A.S. (2007). Export of toxic chemicals – a review of the case of uncontrolled electronic waste recycling. *Environmental Pollution* 149 (2), 131-140.

Yoshida, A. (2013). Recyclable waste trade of mainland China. in Kojima, M., and Michida, E. (ed.), *International trade in Recyclable and Hazardous Waste in Asia*. Northampton, Edward Elgar, 44-50.

Appendix

Export declarations for South Korea consists of a 56-item list which must be filled out when exporting. The shipped products must be identified as either brand new or used. The “condition of goods” item must be specified as either “N” (new) or “O” (used). As the second component, “name of goods”, used goods are specified as “USED” along with the commercial name of the exported product, and new goods lack the “USED” prefix. In this paper, we used the sum of the total amount of shipped goods specified as “O” in the condition of goods and, from among the shipped goods specified as “N”, those having the word “USED” in the name of the goods. The reason for adding the latter criterion is to capture shipments that were mistakenly declared as used electronics for only one component.

The HS Code list of the 5 selected electronics from 2002–2009

[Extra Table for Appendix]

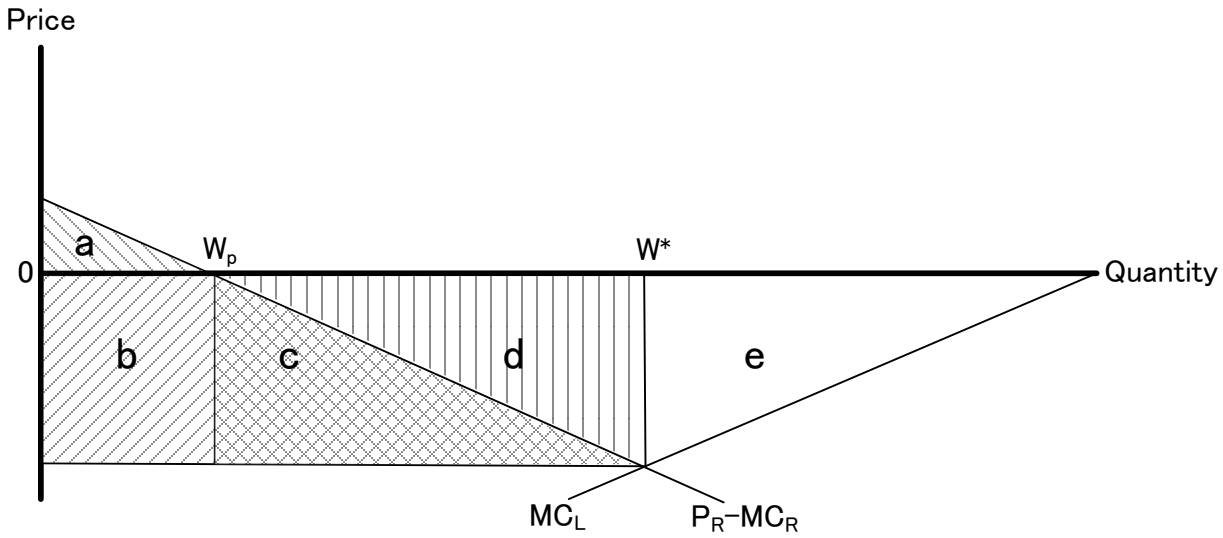


Fig. 8.1. Domestic recycling of computer monitors.

Source: Adapted from Pearce (2001) by author.

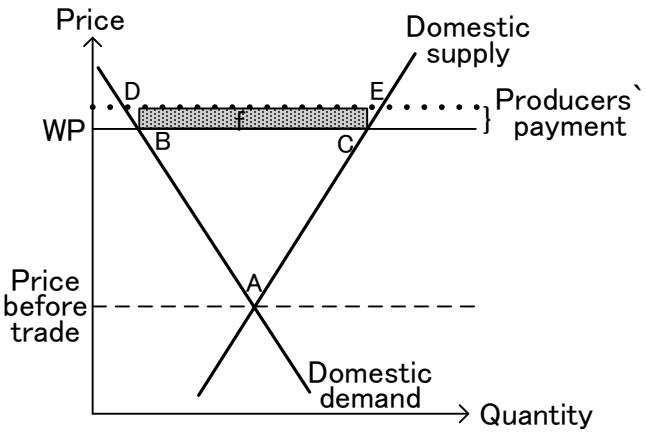


Fig. 8.2 International trade of used computer monitors and producers' cost

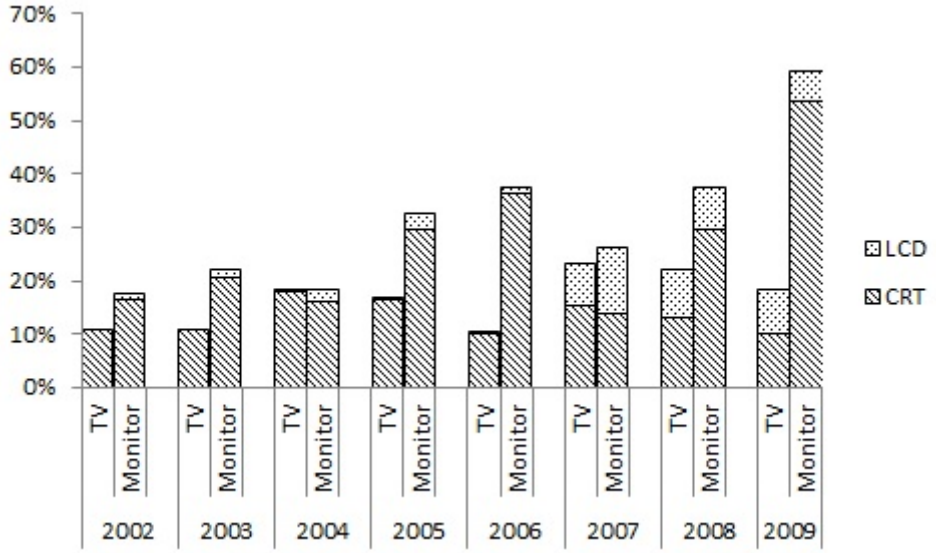


Fig. 8.3. Export rates of used computer monitors and televisions from South Korea during 2002–2009 (weight basis).

Note: Air conditioners, refrigerators, and washing machines are not shown because their export sizes are negligible.

Source: Compiled by author from data in the Korea Customs Trade Development Institute (KCTDI) database.

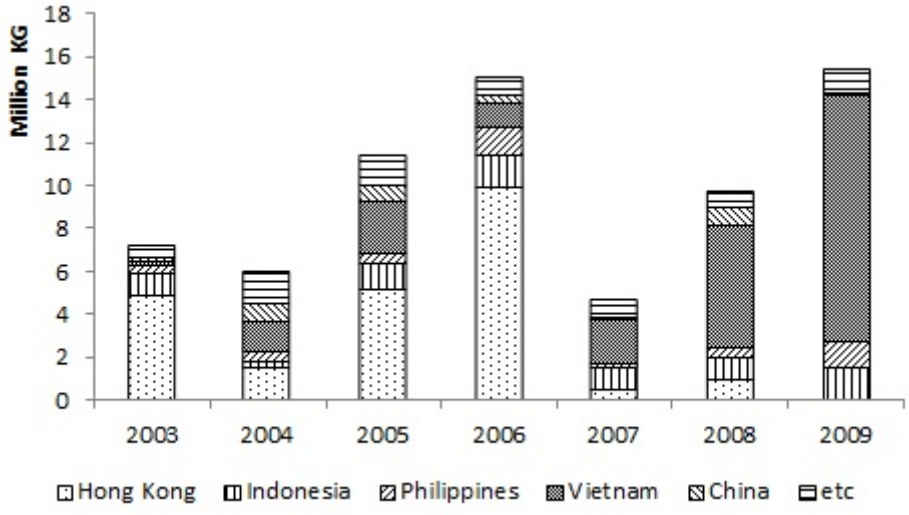
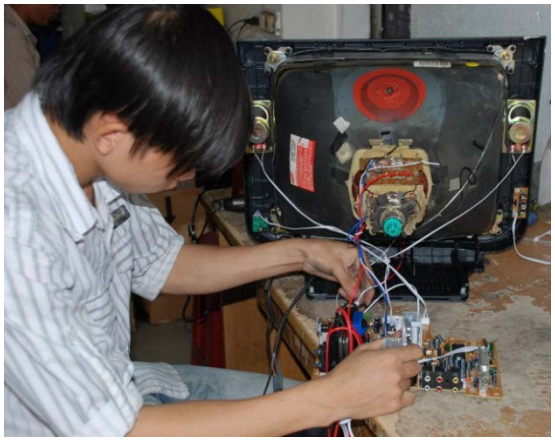


Fig. 8.4. Export destinations of used CRT monitors during 2003–2009.

Source: Compiled by author from data in the KCTDI database.

CRT monitors piled up in Nhat Tao market



Rebuilding a television with a CRT taken from a computer monitor

Rebuilt televisions displayed in Nhat Tao market for sale

Melting process in a plastic recovery factory on Ao Doi street

Fig. 8.5. Recycling of CRT computer monitors in Ho Chi Minh City (Photos by Kim).

Table 8.1. Institutions of WEEE management in South Korea, the EU, and Japan (as of 2014).

	South Korea	EU	Japan
Definition of Producer	Manufacturers and importers[1] above standard[2]	Manufacturers and importers[1]	
Regulated items	Household appliances,[3] IT equipment,[4] etc. (26 types of EEE)	(102 types of EEE)	(8 types of EEE)
Collection (recycling) target (min.)	6 kg per inhabitant per year, in proportion to the shipment share of EPR producers in total domestic shipments by 2016	45% of average weight of EEE placed on the market in the prior three years, from 2016	—
Recovery rate (min.)	65–80%	50–80%	50–70% (laptop computer: 20%)
RoHS (max. level)	Lead (0.1%), Mercury (0.1%), Hexavalent chromium (0.1%), PBB (0.1%), PBDE (0.1%), and Cadmium (0.01%)		
Targeted item of RoHS	All of regulated items	All of regulated items	Regulated items and microwaves
RoHS penalty	Prohibition of sale and a fine below 30 million KRW	Prohibition of sale	Sale with a disconfirming mark
Export of used electronics	Approval of the export of used computer monitors for reuse as legitimate recycling	Monitoring duty / Cost of monitoring on producers / Burden of proof on exporters of used electronics	Specification of Harmonized System (HS) code for used household appliances and display / Prior consultation

Notes: [1]Any person or firm that, under its own brand name, manufactures and sells, or resells, or imports and sells the final electronics.

[2]More than 1 billion KRW of total sales in previous year, or more than 0.3 billion KRW of import amount in previous year.

[3]Air conditioners, clothes dryers, freezers, refrigerators, televisions, and washing machines.

[4]Computers (laptop and desktop) and computer displays (CRT and flat screen).

Source: EU (RoHS Recast, 2011; WEEE Recast, 2012), Japan (JISC0950, 2008; JOP, 2008; JOP, 2014), South Korea (KMOE, 2012b; KMOE, 2014a; KMOE, 2014b; KMOE, 2014c).

Table 8.2. Additional costs (–) and benefits (+) in domestic and international recycling.

	Producer	Exporter	Recycler	Society	Sum
International recycling	–f	f	a	–e	a – e
Domestic recycling	–b – c – d	0	a + b + c	–e	a – d – e
Difference	–f + b + c + d	f	–b – c	0	d

Table 8.3. Additional cost/benefit per unit for international recycling against domestic recycling (KRW).

		Producer	Exporter	Recycler	Government	(Vietnam)	Sum
Benefit	Producer	3,102[a)]	596 [a)]				
	Recycling			3,907 [b)]		(+)	
	Landfill				490 [b) c)]		
Cost	Producer	596 [a)]		3,102 [a)]			
	Recycling			3,426 [b)]		(+)	
	Landfill				186 [b) c)]		
	Health risk					(+)	
Net benefit		2,506	596	-2,621	304	(-)	<785

Sources: a) AEE, 2012; b) AEE, 2013; c) Mok, 2005.